Acquisition Support:
Helping Programs Succeed

Brian Gallagher
Director, Acquisition Support Program
Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

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Standard Form 298 (Rev. 8-98)  
Prescribed by ANSI Std Z39-18
Agenda

State of Acquisition

What is the Department of Defense Doing?

What is the SEI Doing?

Principles of Effective Acquisition

Summary
What is “Acquisition”

Question: What are the key activities that you perform when you acquire systems?
A Strategic Partnership

Acquirer

- Acquisition Planning
- RFP Prep.
- Solicitation
- Source Selection
- Program Leadership
- Insight / Oversight
- System Acceptance
- Transition

Developer

- Plan
- Design
- Develop
- Integrate & Test
- Deliver

Operational Need
The State of Acquisition Practice

The agencies assume the partnership arrangement absolves them of all acquisition management responsibilities...

Virtually all (Air Force) software-intensive systems suffer from difficulties achieving cost, schedule, and performance objectives. GAO

“I'd rather have it wrong than have it late.” A senior manager (industry)

“The bottom line is schedule. My promotions and raises are based on meeting schedule first and foremost.” A program manager (government)

Lack of robust systems engineering practices identified as critical factor in SBIRS-High problems.
Example Program

Background

Large DoD program with multiple, geographically dispersed engineering locations.

Multi-contractor teams (10+) using different processes.

Several million lines of code.

Systems engineering challenges.

Combination of legacy, re-use, COTS integration and new development.

All contractor sites are Maturity Level 3 or higher.

18 months after contract award, the program office conducted a CMMI “Class B” appraisal on the team.
Example Program
Issues Identified

PROJECT MANAGEMENT

• Lack of project plans or having only incomplete, conflicting or out of date project plans

• Ineffective use of Integrated Master Schedule as basis for planning/tracking status across program

• Undefined engineering and management processes on program

• Inability to track and manage actions to closure

• Inadequate cost estimation processes, methods, data and tools

• Inadequate staffing and training project personnel

• Tracking dependencies between or across teams not defined

• Managing project data ad hoc

• Inability to proactively identify and manage risks

ENGINEERING

• Lack of understanding of the program’s requirements

• Inability to trace requirements to architecture/design or to test plans/procedures

• Poor linkage of functional and performance requirements

• Inconsistent requirements management at different levels

• No criteria for making architectural/design decisions among alternatives

• Not capturing entire technical data package (requirements, design and design rationale, test results, etc)

• Efficiency of design process/methods in question

• Late definition of integration and test procedures
Example Program

Issues Identified

SUPPORT

Difficult to identify items in configuration management baselines

Lack of ability to manage individual “versions” in incremental development

Inability to effectively managing changes to work products throughout lifecycle

Not conducting audits to establish/ensure integrity of baselines throughout incremental engineering and development

Inefficient change management process (cycle time, volume of changes)

Roles/responsibilities of change control boards not defined

Quality Assurance audits of products and processes not consistent

QA involvement in system and software engineering processes not consistent

No metrics to manage engineering activities (outside of cost/schedule data)
Complexity in Modern Systems

Many commercial products are the result of a complex mix of subcomponents engineered into a system.

Most DoD weapon and information systems are at least this complex.
Weapon System Complexity
System of Systems Complexity
Acquirer/Supplier Mismatch

**Mismatch**
- mature acquirer
- mentors low maturity supplier
- outcome not predictable

**Matched**
- acquirer and supplier are both high maturity
- highest probability of success

**Disaster**
- no discipline
- no process
- no product

**Mismatch**
- immature acquirer
- mature supplier
- Customer encourages short cuts.
Agenda

State of Acquisition

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Summary
Long History of Software Problems

“[Acquisition directives] do not encourage [iteration]. They essentially forbid it. [Standards] continue to reinforce exactly the document-driven specify-then-build approach that lies at the heart of so many DoD software problems.”

“DoD does not have adequate career paths for software professionals.”

“The application-knowledgeable, technical skilled leaders are the military’s limiting resource in using today’s computer technology.”

“…the hardest part of the software task is the setting of exact requirements … including the relative priorities … for inevitable tradeoffs.”

DoD should be aggressively looking for opportunities to buy in the civilian market tools, methods, environments, and application software.”

Computer security requirements are frequently cited as a reason why [COTS] software cannot be used.”

“Today’s major problems with military software development are not technical problems, but management problems.”

“Many previous studies have provided an abundance of valid conclusions and recommendations. Most remain unimplemented.”

Systems and Software Engineering Organizational Core Competencies

Director, Systems & Software Engineering
Mark Schaeffer SES

Deputy Director
Enterprise Development
Bob Skalamera SES

Deputy Director
Developmental Test & Evaluation
Chris DiPetto SES

Deputy Director
Software Engineering & System Assurance
Kristen Baldwin SES

Deputy Director
Assessments & Support
Dave Castellano SES

CORE COMPETENCIES

- SE Policy
- SE Guidance
  - SE in Defense Acquisition Guidebook
  - Technical Planning
  - Risk Management
  - Reliability & Maintainability
  - Contracting for SE
  - SoS SE Guide
- SE Education and Training
  - DAU SE Curriculum
  - SPRDE Certification Rqmt
- Corrosion
- R-TOC
- Value Engineering

DT&E Policy
DT&E Guidance
T&E in Defense Acquisition Guidebook
TEMP Development Process
DT&E Education and Training
DAU DT&E Curriculum
DT&E Certification Rqmt
Joint Testing, Capabilities & Infrastructure
Targets Oversight
Acq Modeling & Simulation
Energy
DSOC/Acq Tech Task Force

SWE and SA Policy
SWE and SA Guidance
SoS, SA Guides
SWE and SA Education and Training
DAU SW Acq Curriculum
Continuous Learning Modules for SWE, SoS, SA
Software Engineering
Acquisition Support
Software Engineering Institute (SEI)
Process Improvement
CMMI Sponsor
DoD/National Software Investment Strategy

Support of ACAT I and Other Special Interest Programs (MDAP, MAIS)
Assessment Methodology (Program Support Reviews - PSRs)
T&E Oversight and Assessment of Operational Test Readiness (AOTR)
Systems Engineering and Developmental Test Planning and Support
Lean/6-Sigma Training/Cert

Acquisition program excellence through sound systems and software engineering
# DoD Software Strategy Summit to Focus Activities

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<thead>
<tr>
<th>Software Acquisition and Sustainment</th>
<th>Software Engineering</th>
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<tr>
<td>Software issues not addressed early in lifecycle</td>
<td>Weak linkage between software requirements and capabilities/porfolios</td>
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<tr>
<td>Software requirements not well defined at program start</td>
<td>System development methods do not properly leverage software ability to rapidly field new capability</td>
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<tr>
<td>Management has limited visibility into software development processes and status</td>
<td>Systems and software engineering lifecycles not always consistent or harmonized</td>
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<td>Risk areas – single point failures not adequately addressed, e.g., single software providers, incomplete data rights, key personnel stability, life cycle support of COTS</td>
<td>Software considerations not consistently addressed in architectures</td>
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<tr>
<td>Acquirers do not adequately address software sustainment and total life cycle early in the program</td>
<td>Inadequate software estimating methods, e.g., COTS/NDI; best practices not applied</td>
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<td>Some agencies contract before engineering is complete, prior to system design and development</td>
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### Human Capital

- Experienced system & software engineers seem missing from key DoD leadership positions
- Shortage of highly experienced software managers, architects, domain and technical experts
- Eroding depth and breadth of experience for personnel in DoD
- Young people may consider system and software engineering as a career dead end
- Emerging skill set may be needed for future complex DoD systems, e.g., systems of systems

### Policy

- PMs need assistance with software policy and analysis
- Arbitrary separation of weapon and information technology software policies
- Policy implementation guidance and follow-up monitoring is limited
- Department needs software group with good expertise to oversee and implement policy
- Need capability to share policy and guidance information

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October, 2006
Agenda

State of Acquisition

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Principles of Effective Acquisition

Summary
Acquisition Support Program

Vision

*Predictable success in the acquisition of software and systems*

Overall Goal

A continuous program of applying new software engineering knowledge and techniques to increasingly complex program environments and amplifying their application through the acquisition infrastructure throughout the DoD, Federal Agency and other acquirer communities.
Acquisition Support Program

Strategies

• *Impact individual programs* – work with key DoD, Federal Agency, and other acquisition programs to help them meet their objectives

• *Impact acquisition organizations* – help establish a learning environment within acquisition organizations

• *Define, integrate and transfer knowledge* – help improve the state of the practice
ASP Areas of Work

- Mission Assurance
- Process
- S/W Engineering
- Systems Engineering
- Architecture
- Interoperability
- Security

Department of Defense Programs

Civilian Agency Programs

Knowledge Integration, and Transfer

Improved Systems

Improved State of Practice
ASP Operational Plan

Acquisition Support Program applies Software and Systems Technologies

Feedback from direct support and community learning improves ASP practices & SEI technologies

• Workshops, Classes, Seminars

• Tailored learning via Acquisition Communities of Practice
  • Army, Navy, Air Force, Defense and Intel Agencies
  • Software Collaborator’s Network
  • Conferences
  • MITRE, Aerospace
  • Defense Acquisition University
  • OSD Best Practices
  • Civil Agencies
  • Universities
  • US-UK-AUS Working Groups

Direct Benefit to Acquisition Programs

Indirect Benefit to Similar Programs
SEI Acquisition - Footprints

Army

- ASSIP, Future Combat Systems, PEO Aviation, AMRDEC SED, CECOM SEC, AMCOM, PM Aviation, AMPS/JMPS, PM TAPO, US Army Reserve, PM FBCB2, AMRDEC AADL

Navy

- DDG-1000, Common Link Integrated Processor, Littoral Combat Ship, Multi-Mission Maritime Aircraft, Open Architecture and DASN IWS

Air Force


Joint/Other DoD

- Joint Strike Fighter, JSSEO, MDA, DFAS

Intelligence Agencies


Civil Agencies

- Internal Revenue Service, Department of Veterans Affairs, Nuclear Regulatory Commission, National Aeronautics & Space Administration, US Coast Guard
Themes

**Educating the acquirer**
Imparting requisite software knowledge to define, monitor, and manage a program; training and mentoring; effective teaming.

**Advancing software-aware system engineering**
Advising on requirements engineering and management; system architecting, design, construction, and integration; verification and validation; and sustainment and refresh techniques that suit complex environments.

**Facilitating horizontal integration**
Guiding the acquirer on development of robust architectures, interoperable systems, integration of disparate data, data mining, integrating the “enterprise,” etc.

**Overcoming process aversion**
Communicating the value of process, modeling processes to identify inefficiencies and the need for improvement.

**Overcoming technology aversion**
Understanding prevalent attitudes, ensuring people are considered in technology solutions.

**Tempering technology worship**
Performing robust risk-benefit analyses, defining feasible off-ramps.
Software Acquisition

SURVIVAL SKILLS

Bridging the gap between your current crisis and software best practices
Software Acquisition Survival Skills

3-day course aimed at PMs and program office personnel

Topics:

- Risk Management
- Pre-Award Activities
- Requirements Management
- Systems Engineering
- Technical Evaluation
- Software Architecture
- Managing with Metrics
- Process Management
- Concept Integration
Leveraging Customer Engagements

ASP uses customer engagements to improve the state of the practice of software and systems acquisition in the following ways:

• Catalyst – *small investments for large impact*

• Integration – *the whole is greater than the sum of the parts*

• Packaging & Dissemination – *best practices amplified*
Catalyst: Acquisition Strategy Guidance

Question from ASA/ALT

- What is the appropriate strategy when acquiring software-intensive systems?

Scope

- Mine & distill existing know-how
- Provide *workbook*, not *guidebook* – “it depends”
- Concise, practical, repeatable process for DoD programs

Funded as part of Army’s Strategic Software Improvement Program

Developed based on DoD 5000; piloted with Army programs

Results

- Techniques for Developing an Acquisition Strategy by Profiling Software Risks (CMU/SEI-2006-TR-002) and excel tool available for download
Integration: Quality Assessment of System Architectures and their Requirements (QUASAR)

A method on the use of Quality Cases for assessing the quality of

- Software-intensive System/Subsystem Architectures and the
- Architecturally-Significant Requirements that drive them

Developed based on funded work on the JSF program

Integrated technology from

- Assurance Case research
- Quality Attribute and Architecture Evaluation research
- Method Development from Process research

Results

- Method description documented for subsequent use (CMU/SEI-2006-HB-001)
- Effort lauded by Mike Bossert, F-35 Air System Architect, JSF Program
Packaging & Dissemination: Building Awareness of CMMI in the Acquisition Community

NDIA Workshop & Summit on CMMI Use in DoD Programs

Piloting new and innovative ways to use CMMI to encourage use of effective practices on DoD programs

- AF programs: KG 3X, JET, JMPS, TSAT
- Navy programs: MMA, CLIP
- Intelligence Community programs: NSA, NRO

Results

- Understanding and Leveraging a Supplier’s CMMI Efforts: A Guidebook for Acquirers (CMU/SEI-2007-TR-004)

“Level ‘X’ companies often do not perform at that level on all programs”

“DoD expects that if you have achieved high maturity, the next program will perform at that maturity”

– Mark Schaeffer
Director, Systems and Software Engineering
Agenda

State of Acquisition

What is the Department of Defense Doing?

What is the SEI Doing?

Principles of Effective Acquisition

Summary
The Quest for the “Silver Bullet”

- Open Architecture
- Acquisition Reform
- Agile Acquisition
- Evolutionary Acquisition
- Capability-Based Acquisition
- Net-Centric Warfare
- Time-Certain Development
- System Engineering Revitalization
- Interoperability
- Total System Performance Responsibility
- CMMI
- Performance-Based Acquisition
- Insight versus Oversight
- Service-Based Acquisition
- Architecture-based Development
- Lean Six Sigma
Principle-Based Decisions

“Principle” Defined:

The collectivity of moral or ethical standards or judgments: a decision based on principle rather than expediency.

Decisions to pursue a given acquisition approach should be grounded on underlying principles designed to increase the effectiveness of acquiring and deploying systems.

The following describes the Seven Principles of Effective Acquisition.
Seven Principles of Effective Acquisition

- Continuous Process Improvement
- Open Communication
- Shared Product Vision
- Global Perspective
- Team Risk Management

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The Core Principle: Open Communication

Encouraging free flowing information at and between all stakeholders.

Enabling formal, informal, and impromptu communication.

Using consensus-based processes that value the individual voice (bringing unique knowledge and insight to evolving mission capabilities).
The Three Sustaining Principles

Team Risk Management

Continuous Process Improvement

Continuous Product Improvement
Team Risk Management

Evolving the mission capabilities
by continuously mitigating
operational, development,
and acquisition risks.

All stakeholders participating in managing the project
by managing the risks.
Continuous Process Improvement

Maturing the acquisition, development, and operational processes to meet the mission objectives.

Employing a common process improvement framework and language to align and enhance process capability.
Continuous Product Improvement

Enhancing the mission through evolutionary delivery of enhanced capabilities.

Delivering an initial capability on the first promise date, with the demonstrated capability to deliver improved or updated capability in on a regular, dependable schedule.
The Three Defining Principles

Forward-Looking View

Global Perspective

Shared Product Vision
Forward-Looking View

Seeing a common *tomorrow* against which all stakeholders can measure potential breakthroughs and risks.

Managing project resources and activities while anticipating uncertainties.
Global Perspective

Sharing a single mental model of project success that crosses all boundaries between acquirer, developer, and operator.

Viewing enhancements within the context of the operational mission.

Recognizing both the potential value of opportunity and the potential impact of adverse effects.
Shared Product Vision

Developing and sustaining a common conception of the product being built - one that can be stated simply and briefly, and is founded on common purpose, shared ownership, and collective commitment among the stakeholders.

Focusing on results.
Seven Principles of Effective Acquisition

- Continuous Process Improvement
- Open Communication
- Shared Product Vision
- Team Risk Management
- Global Perspective
- Continuous Product Improvement
- Forward-Looking View
Agenda

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Principles of Effective Acquisition

Summary
Summary

The SEI, through the Acquisition Support Program, works directly with key acquisition programs to help them meet their objectives.

ASP looks for common themes and solutions and packages them for wider dissemination and use.
For More Information

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